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PHENOTYPIC STABILITY FOR YIELD AND SOME DEVELOPMENT TRAITS IN *VIGNA MUNGO* (L.) HEPPER

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ABSTRACT

Nineteen diverse and elite genotypes of Urdbean[Vigna mungo (L.) Hepper] were evaluated in three different environments during 2014-15 of Uttar pradesh. Highly significant variance due to genotypes against pooled deviation revealed the presence of genetic variability for the traits under investigation. The component genotypes x environment interaction being highly significant indicated that genotypes interacted considerably to environmental conditions in different environments. The predominance of linear component would help in predicting the performance of the genotypes across environments. The genotypes KU 301 and KU 96-3 possessed high mean values for grain yield and non-significant deviation from regression coefficients approaching unity with non-significant deviation from regression, were most suitable across the environments.

KEYWORDS: GxE, Urdbean, Stability

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INTRODUCTION

Urdbean [*Vigna mungo* (L.) Hepper] is important pulse crop grown under marginal and dry land conditions. Environmental conditions have always been major constraint for stable yield. When grown over diverse environments, Uttar Pradesh is the state of varied agro climatic conditions and urdbean is the most important kharif pulse crop. Yield is a complex character and is multiplicative product of many factors called yield components, which are greatly influenced by environmental fluctuations. Therefore, testing for stability in performance is necessary in order to identify a stable variety so that the total production of urdbean can be stepped up. Aimed at this, nineteen diverse elite strains/varieties were tested in different climatic conditions of the state and analysed for stability of performance. The results of such an analysis are reported in this paper.

MATERIALS AND METHODS

Nineteen diverse and elite strains/varieties of urdbean [*Vigna mungo* (L.) Hepper], developed in different agro-climates of India, were grown at three diverse locations viz., Experimental Block of Oil Seed Research Block, Kanpur, Crop research Station, Daleepnagar and Regional Research Station, Saini. At each location, the material was planted in randomized block design with three replications. Each plot had 3 rows of 5 m length spaced 10 cm within and 30 cm between rows. The recommended agronomic practices were followed to raise a good crop. Leaving the border plant observation recorded on randomly taken 10 competitive plants/plot for plant height, number of effective branches/plant, days to 75 percent maturity and grain yield/plot (converted into kg/ha).

Plots means of different characters were used for statistical analysis. The data were first subjected to the analysis of variance to test the significance of genotype x environment interaction. Various stability parameters (μ, β and S'd were estimated using models proposed by Eberhart and Russell (1966) and Perkins and Jinks (1968).

RESULTS AND DISCUSSIONS

The analysis of variance (Table 1) revealed that except for number of branches/plant, the mean difference amongst the genotypes and environments were highly significant for all the characters when tested against genotype x environment interaction component. The results, thus, satisfied the basic requirement for such studies since they indicate that the average performance of genotypes with respect to traits under study varied significantly in different environment and that the varieties also varied significantly so far as their average performance over all the environments was concerned.

Table 1: Analysis of Variance for Metric Traits Pooled Over Three Environments

Source	Df	Mean Sum of Squares			Yield
		Plant Height	Branches Per Plant	Days to 75% Maturity	
Varieties	18	741.314**	0.182	30.562**	18.558**
Environments/joint regression	2	19059.915**	1.738**	992.315**	216.162**
Varieties x Environment	36	134.222**	0.183**	4.117**	6.166**
Env. + (Var. x Env.)	38	1094.311**	0.246	56.127**	14.376**
Env. (Linear)	1	38119.831**	3.475**	1984.665**	432.304**
Var.xEnv.(Linear)/Hetero.Between regression	18	124.186	0.162	4.529	1.853
Pooled deviation	19	64.665	0.156	3.504	4.244
Remainder	18	68.257	0.164	3.699	4.480
Pooled error	162	72.937	0.100	2.029	2.567

*P=0.05 **P=0.01

The genotype x environment interaction component was also significant revealing thereby that genotypes interacted with the environmental conditions. The linear component of variation was highly significant indicating that the differences among the regression coefficients pertaining to various genotypes on the environmental means were real. However the variances due to pooled deviations were not significant which indicated that the major component for differences in stability is due to the linear regression and not the deviation from the linear function. The heterogeneity between regression and remainder mean sum of square were not significant for all the characters.

Comparison of Two Stability Models: In table 2, β^E stands for regression coefficient as per model given by Eberhart and Russel (1966) and β^p is the regression coefficient for Perkins and Jinks model (1968). It was evident that order of ranking of various genotypes both with respect to response (b) and stability was the same under both the models. This was expected because the letter model being β^E -1, is in no way different from the former both the models are associated with each other such that ribi and s^2d of former is equivalent to (μ +di) (1+βi)and s^2d of letter, respectively. Consequently the ranking pattern of the genotypes under Perkins and Jinks model will be similar to the pattern under Eberhart and Russell model.

Mean Performance and Stability Parameters: The range of variation for mean performance (μ), linear sensitivity coefficient (β) and non-linear sensitivity coefficient (s^2d) for all the characters are presented in table 2 and 3.

Simultaneous consideration of mean and stability parameters revealed that KU 301, KU 96-3 and T 9 had dwarf plant height, β =1 and s^2d =0. Accordingly these genotypes appeared promising for hybridization in order to combine all the three aspects of adaptation.

The mean and stability parameters for branches/plant revealed that Pant U 19, Pant U 26, KU 301, Pant U 26, T 9, KU 333 and PDU 1 had average or above average number of effective branches/plant with high stability. These genotypes appeared promising from adaption point of view. KU 301, KU 96-3 and T 9 had dwarf plant, height with β=1 and s^2d=0 (Table 2).

So far stability of days to maturity is concerned, KU 88 and KU 96-5 had responsive behaviour and their performance can be predicted with some reliance over the environments. KU 98-3, PDU 2, KU 96-3 and PDU 1 had high unpredictability. Rest genotypes had average stability as both βi and s^2d were non-significant. Considering the mean performance and stability parameters of the genotypes KU 357, KU 301, T 9 and Pant U 30 appeared significantly early maturing with high stability (Table 3).

KU 301, Pant U 30 and PDU 1 yielded significantly higher (Table 3) than the population mean, x=9.10 q/ha. None of the genotypes had linear regression coefficient statistically greater than one and less than one, thus had above average sensitivity. S^2d was not significant for fifteen genotypes. Positive and significant s^2d for PDU 2, KU 96-3, KU 333 and PDU 1 indicated that uncertain fluctuations could decrease the yield of these genotypes. Although for this trait KU 98-3, KU 357, KU 99-25, PantU 26, KU 301, KU 345, T 9 and Pant U 30 were stable with average/above average yield potential, unit regression coefficient and deviation from regression was as small as zero but KU 301 and Pant U 30 were of note worthy having significant higher yield.

CONCLUSIONS

Considering the overall performance of the genotypes studied with respect to various traits, it is evident that KU 301 and KU 96-3 are potential genotypes having stable performance in all the urdbean growing areas of the State. High yield and stability of these genotypes appeared due to high number of effective branches. These genotypes are early in maturity with dwarf plant stature thus also suitable for intercropping – one of the prevalent cropping system. Pant U 19, Pant U 26, KU 357, Pant U 30, T9, KU 98-3, KU 333 and PDU 1 appeared promising for various traits from adaptation point of view and can be used in hybridization programme to develop stable various for the future for different agroclimates of Uttar Pradesh.

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APPENDICES

Table 2: Estimates of Stability Parameters Based on Two Models for Plant Height and Branches per Plant

Variety	Plant height							Branches per plant						
	Env. I	Env. II	Env.II I	μ	β^E	β^P	s^2d	Env. I	Env. II	Env.II I	μ	β^E	β^P	s^2d
PantU 19	39.65	115.13	117.50	90.76*	1.422*	0.422*	-71.487	2.98	2.75	2.50	2.74	-0.677	-1.677	-0.071
KU 98-3	26.48	56.13	42.25	41.62	0.451	-0.549	-41.345	1.25	2.75	2.00	2.00	2.120	1.120	0.203**
KU 92-1	48.13	79.63	89.50	75.75	0.738	-0.262	-21.881	2.20	3.50	2.50	2.73	1.491	0.491	0.420**
KU 88-2	51.50	111.88	116.50	93.29*	1.109	0.109	126.859*	3.30	2.50	2.75	2.85	-1.279	-2.279	-0.065
KU 357	42.78	51.76	94.25	76.26	0.886	-0.114	37.148	1.95	2.75	2.50	2.40	1.279	0.279	-0.065
KU99-25	50.80	111.25	105.75	89.27	1.046	0.046	-33.617	2.10	2.50	3.00	2.53	1.259	0.259	0.017
PantU 26	47.30	122.75	112.25	94.10**	1.285	0.285	-47.955	2.35	3.00	3.25	2.87	1.488	0.488	-0.074
KU 301	32.96	82.88	59.75	98.52	0.762	-0.238	13.082	2.20	2.75	2.75	2.57	1.049	0.049	-0.100
Co 4	49.10	100.88	87.50	76.04	1.014	0.014	-72.869	2.05	2.50	2.50	2.35	0.859	-0.142	-0.100
KU 345	32.20	98.88	78.00	75.33	0.771	-0.229	-15.864	1.80	2.75	2.25	2.27	1.318	0.318	0.334
KU 307	50.70	116.25	111.00	86.48	0.933	-0.067	-44.334	2.10	2.75	2.00	2.28	0.498	-0.502	0.186*
PDU 2	45.90	114.63	97.00	87.44	1.409*	0.409*	353.972*	3.25	2.25	3.50	3.00	-0.671	-1.671	0.693*
KU 88	28.98	110.38	87.00	81.04	1.019	0.019	24.853	2.08	2.50	2.75	2.44	1.059	0.059	-0.072
KU 96-3	30.18	75.25	62.75	55.66	0.755	-0.245	-70.216	1.88	3.25	2.75	2.63	2.129	1.129	0.039
T 9	30.53	82.50	80.50	64.40	0.921	-0.079	-15.547	1.98	3.00	3.00	2.66	1.956	0.946	-0.990
PantU 30	63.48	107.63	81.00	73.05	1.226	-0.226	-20.236	1.80	2.75	2.75	2.43	1.813	0.813	0.090
KU 333	40.55	130.25	116.25	103.33**	1.111	0.111	-72.385	2.35	2.75	3.25	2.78	1.259	0.259	0.017
PDU 1	55.50	114.13	95.25	83.31	1.205	0.205	-69.534	2.25	2.50	3.00	2.58	0.972	-0.028	0.019
KU 96-5	55.50	111.13	102.00	89.54	0.940	-0.060	-66.135	2.08	2.25	3.00	2.44	1.077	0.077	0.171*
Mean	42.44	102.28	91.37	78.67	1.000	-	-	2.21	2.78	2.74	2.50	1.000	-	-
SE+/-	-	-	-	5.69	0.180	-	-	-	-	-	0.28	0.922	-	-
CDat5%	-	-	-	11.226	0.356	-	-	-	-	-	0.554	1.806	-	-
CDat %	-	-	-	14.85	10.470	-	-	-	-	-	0.731	2.406	-	-
Ij	-36.26	-											-	-

Table 3: Estimates of Stability Parameters Based on Two Models for Days to 75 Per Cent Maturity and Yield

Variety	Days to 75 per cent maturity							Yield (Q/ha)						
	Env. I	Env. II	Env.II I	μ	β^E	β^P	s^2d	Env. I	Env. II	Env.II I	μ	β^E	β^P	s^2d
PantU 19	110.75	70.01	111.50	97.42	0.888	-0.112	-1.669	8.29	5.22	12.95	8.82	1.139	0.139	-1.751
KU 98-3	96.75	87.25	103.50	95.83	1.078	0.078	9.771	10.25	8.17	14.89	11.10	0.985	-0.015	-0.959
KU 92-1	104.50	90.50	105.50	100.17	1.158	-0.158	-1.440	6.59	2.83	7.71	5.71	0.735	-0.267	-1.729
KU 88-2	106.00	96.50	107.00	103.17**	0.801	-0.199	-1.929	6.01	3.01	10.18	6.40	1.057	0.057	-2.058
KU 357	99.75	87.00	101.00	95.92	1.071	0.071	-1.801	10.55	5.17	14.36	10.03	1.367	0.367	-2.458
KU99-25	103.00	86.00	103.00	97.33	1.348	0.348	0.928	10.92	4.09	15.12	10.04	1.643	0.643	-2.068
PantU 26	101.50	88.25	101.00	96.92	1.026	0.026	0.746	11.38	6.70	11.08	9.72	8.668	-0.332	0.975
KU 301	96.50	87.75	101.50	95.25	0.935	-0.065	3.595	11.33	10.78	16.80	12.97**	0.872	-0.128	2.297
Co 4	103.50	86.00	104.50	98.67	1.277	0.277	-1.187	10.29	4.39	11.56	8.75	1.078	0.078	0.128
KU 345	104.00	91.50	105.50	100.17	1.039	0.039	-1.649	11.68	4.79	11.70	9.41	1.062	0.062	3.907
KU 307	119.50	80.99	119.00	105.83**	0.808	-0.192	3.801	7.03	2.76	11.88	7.22	1.348	0.348	-2.275
PDU 2	103.00	92.00	101.00	98.67	0.776	-0.224	-1.895	12.11	4.27	11.71	9.36	1.134	0.134	7.147
KU 88	103.00	87.25	106.00	189.75	1.393*	0.393*	17.114**	6.65	3.24	7.48	5.79	0.638	-0.362	-1.740
KU 96-3	96.00	87.75	104.00	95.92	1.030	0.030	2.366	8.91	9.86	15.12	11.16	0.746	-0.254	9.107
T 9	95.50	87.25	100.00	94.25	0.871	-0.109	-1.902	8.51	7.57	12.95	9.68	0.782	-0.218	-0.001
PantU 30	98.25	87.25	100.50	95.33	0.980	-0.220	-0.734	11.13	10.78	15.60	12.50*	0.698	-0.302	0.821
KU 333	106.00	94.75	106.00	102.25**	0.892	-0.108	0.939**	9.76	2.14	8.41	6.77	0.963	-0.037	9.379
PDU 1	103.00	88.50	101.50	97.67	1.077	0.077	0.077	9.81	9.75	19.23	12.93**	1.367	0.367	14.468
KU 96-5	104.00	99.00	107.00	103.33**	0.532*	-0.1468*	-	5.63	1.68	6.46	5.59	0.720	-0.280	-1.325
Mean	102.87	88.29	104.63	98.57	1.000	-	-	9.29	5.64	12.38	9.10	1.000	-	-
SE+/-	-	-	-	1.32	0.183	-	-	-	-	-	1.46	0.431	-	-
CDat5%	-	-	-	2.614	0.362	-	-	-	-	-	2.981	0.853	-	-
CDat1%	-	-	-	3.445	0.477	-	-	-	-	-	3.811	1.125	-	-
Ij	4.09	10.31	6.04	-	-	-	-	0.18	-3.46	3.28	-	-	-	-

*P =0.05, ** P=0.01 E= Eberhart and Russell model, P= Perkins and Jinks